

# Chapter 3

## Competition and Coordination in a Fashion Supply Chain with Wholesale Pricing Schemes

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### ABSTRACT

*This chapter considers a two-echelon supply chain where a supplier determines his production quantity and a retailer chooses her order size and retail price for each period in an infinite horizon. Under a price-discount sharing (PDS) scheme, the supplier's wholesale price linearly depends on the retail price. We develop a stochastic game in which these two supply chain members maximize their discounted profits. We show that a unique Nash equilibrium solution exists for each period, and over the infinite horizon the supplier chooses a stationary base stock policy whereas the retailer's equilibrium solution could be non-stationary. Next, we investigate the problem of whether or not a wholesale pricing scheme can coordinate the supplier and the retailer, and derive the conditions for supply chain coordination. Moreover, we use Nash arbitration scheme to allocate the system-wide profit between the supplier and the retailer.*

### INTRODUCTION

During the past decade, many academics and practitioners have paid much attention to supply chain coordination, which is achieved when decisions made by members of a supply chain are

identical to globally optimal solutions maximizing total profits or minimizing total costs in the supply chain; see Chopra and Meindl (2004, Ch. 10). Two natural questions regarding the issue arise as follows: What mechanism could be applied to coordinate a supply chain? And how could we implement the mechanism? As Cachon (2003) discussed, a common approach is to design an

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appropriate contract, and in recent years a number of publications are concerned with supply chain coordination with contracts (e.g., side-payment, buy-back, revenue sharing, profit-discount sharing schemes, etc.).

In practice, many academics and practitioners have identified the importance of improving the performance of an entire supply chain, and focused on the question of how to effectively gain supply chain coordination and integration for the improvement. Next, we briefly review several papers concerning the coordination of fashion supply chains. Kincade et al. (2002) conducted a survey and revealed that the benefits of retailers in the apparel industry are greatly related to the financial promotional support from manufacturers. Motivated by a real case in the apparel industry, Eppen and Iyer (1997) developed a stochastic dynamic programming model to investigate a backup agreement for a fashion supply chain involving a catalog company and a manufacturer. Under the agreement, the catalog company commits to a number of units for a certain fashion season, and the manufacturer holds back a percentage of the committed units and delivers the remaining units before the start of the season. It was shown that the backup agreement can increase both the catalog firm's and the manufacturer's expected profits. Indu and Govind (2008) discussed the practices of three European apparel companies (Zara, H&M, and Benetton) that have successfully integrated their fashion supply chains and increased their profits. Kurata and Yue (2008) examined the scan-back (SB) trade deal—a special type of trade promotion used in fashion supply chains—that monitors a retailer's sales via an IT system. They showed that both the retailer and the manufacturer can benefit from the SB trade deal if the SB deal is accompanied by a buyback contract. In addition, it has been widely recognized that the bullwhip effect that increases the variability of production and order quantity negatively impacts supply chain performance. Cachon and Terwiesch (2006, Ch. 14) concluded that such an effect has

been one of two major challenges to supply chain coordination, and discussed several major causes resulting in the undesirable phenomenon: order synchronization, order batch, trade promotion and forward buying, reactive and overreactive ordering and shortage gaming.

Restricting our attention to trade promotion and forward buying, we find a number of evidences about the widespread use of trade promotion and discussions from both academic and practical perspectives. As a survey conducted by MEI Computer Technology Group Inc. in 2010 indicates, trade promotion (e.g., wholesale price reduction) is extensively applied in the consumer packaged goods (CPG) industry, and there is an increased emphasis on improving its effectiveness. According to Investopedia and TechTarget, the CPG industry is one of the largest in North America, valued at approximately US\$2 trillion; some examples of CPGs are food and beverages, footwear and apparel, tobacco, and household products. Ailawadi, Farris, and Shames (1999) stated that trade-promotion expenditures in this industry increased from less than 35 percent in 1983 to nearly 49 percent in 1994, and its budget was more than twice the media advertising budget. The experiences in real business world testify to the conclusions presented in Cachon and Terwiesch (2006, Ch. 14) and Chopra and Meindl (2004, Ch. 10): Trade promotion could result in retail opportunism. When a manufacturer temporarily cuts his wholesale price in order to attract and keep customers, some retailers may use the offer to increase their own margins by purchasing more for future periods rather than sharing the promotion with consumers. This is known as forward buying. Such a response is troubling the manufacturer since he cannot pass the low price to end customers through the retailers and the retailers' opportunistic order behavior leads to the bullwhip effect. On the other hand, without trade promotion, the manufacturer may suffer a significant decline in market share if the competitors continue with trade promotion. More

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